transition aluminas of this invention exhibit a low angle x-ray diffraction peak corresponding to a lattice spacing of at least 2.0 nm and wide angle diffraction peaks characteristic of an atomically ordered transition alumina. These mesostructured transition aluminas have surface areas and pore volumes that are substantially larger than conventional transition aluminas. For example, commercial grades of transition aluminas have only textural porosity and lack the ordered mesoscopic network structure of the present convention. Typical surface areas and pore volumes for these commercial grades of transition aluminas, including the most commonly used gamma-alumina, are in the range 200 - 250 m^2/g and 0.35 - 0.50 cm^3/g. In contrast, the mesostructured transition aluminas of this invention, which we denote as MSU-γ, typically have surface areas beyond the 200 - 250 m^2/g range and pore sizes well beyond 0.50 cm^3/g. These large surface areas and pore volumes make the mesostructured MSU-γ alumina and other transition aluminas of this invention particularly attractive as catalysts and catalyst support. Gamma-alumina, for instance, is widely used as a catalyst component in petroleum refining. This oxide, in combination with clay, meta-kaolin, zeolites, and other oxides, comprises an important active ingredient in commercial petroleum cracking catalysts. The mesostructured gamma-alumina of this invention is expected to be an even better petroleum refining catalyst